

**(19) Japanese Patent Office (JP)**  
**(12) Publication of Unexamined Patent Application (A)**

(11) Unexamined Patent Application No.: S54-116747  
(43) Unexamined Patent Application Date: September 11, 1979  
Request for Examination: Not yet submitted  
Number of Inventions: 1  
Total pages: 4

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(51) Int.CL <sup>2</sup>	Identification Symbol	(52) JP CL	JPO File Number
F 23 N 5/10		67 E 9	7715-3K
F 23 D 13/10			6689-3K
F 23 N 5/10			7411-3K

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(54) Title of Invention: Oxygen Deficiency Safety Device  
(21) Patent Application No.: S53-24290  
(22) Patent Application Date: March 2, 1978  
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### Certification

This is to certify that JP Publication No. S54-116747 was translated by Japan-America Management, Ltd. from Japanese into English, and that it represents an accurate and faithful rendition of the original text to the best of my knowledge and belief.

By:

Mario Cricola  
Manager  
September 13, 2004

## Specification

### 1. Title of the Invention

Oxygen Deficiency Safety Device

### 2. Claim(s)

(1) An oxygen deficiency safety device that is comprised of a low-power detection burner, a burning detection sensor, and a valve that opens with a detection signal from the sensor; and which is characterized by having the aforementioned valve in the fuel passage before (the gas) reaches gas burning appliances.

(2) The oxygen deficiency safety device in the Scope of Patent Claims Item. No. 1, which is characterized by having at least a detection burner and a burning detection sensor inside a case that has an air inlet and air outlet.

(3) The oxygen deficiency safety device in the Scope of Patent Claims Item No. 1, which is characterized by having a primary-flame outlet and a secondary-flame outlet separated in the detection burner.

(4) The oxygen deficiency safety device of the Scope of Patent Claims Item No. 3, which is characterized by having a thermocouple in the heated zone by the primary-flame at the primary-flame outlet and the heated zone by the secondary-flame at the secondary-flame outlet so that a valve is opened when there is a certain difference in the thermo-electromotive force between these thermocouples.

(5) The oxygen deficiency safety device the Scope of Patent Claims Item No. 1, which is characterized in that the valve and an electric switch are connected.

### 3. Detailed Explanation of the Invention

This invention relates to an oxygen deficiency safety device that prevents various accidents due to an oxygen deficiency.

The current situation is that the air-tightness of rooms has been improved due to innovations in housing structures and, accordingly, various accidents are often caused by heating appliances.

More specifically, when a gas burning appliance, for instance, is used in an air-tight room, first, the oxygen concentration in the air drops, and the so-called oxygen-lacking state is created and a large amount of CO is generated due to incomplete burning. Also, as this state advances, the burning (flame) is extinguished, and unburned gas flows out. Thus, accidents such as death due to oxygen deficiency, CO poisoning, and explosion of unburned gas can occur.

Conventionally, pilot flame safety devices using thermocouples have been most often used as heating safety devices, but this type of safety device can function only for burning (flame) extinguishing and does not function at all for oxygen deficiency or CO detection.

Also, a different type (of safety device) such as a gas leak warning device has been used, which detects unburned gas in a room and activates a buzzer, etc. but this type also, the same as the above, has no function for oxygen deficiency or CO (detection).

This invention intends to eliminate such conventional disadvantages, and working examples of it are discussed along with attached illustrations.

Referring to Fig. 1, a, b, c…… are heating appliances such as a gas water boiler, a gas stove, and a portable gas heater placed in an ordinary house, and the main gas passage, 1, is provided with an oxygen deficiency safety device, 2.

The above-mentioned oxygen deficiency safety device 2 is placed in a room, 3, the structure of which is shown in Fig. 2 and Fig. 3.

That is, number 4 is a case that is provided with air inlet, 5, on both sides, an air outlet, 7, with a protective guard, 6, on the top wall, a flame checking window, 8, an operation knob, 9, on the front surface, a gas inlet pipe, 10, and a gas outlet pipe, 11, in the bottom, and (this case) is secured, for example, on a wall of room 3 via a bracket, 12. Next, the inside structure (of the case) is shown in Fig. 3. Number 13 is a push-and-turn type gas cock where an electromagnetic valve, 14, is connected at the gas inlet side. By pushing and turning the operation axle, 15, via operation knob 4 (*sic*), first the normally-closed type pilot valve, 16, opens, and the gas that flows (through) the pilot passage, 17, and reaches the pilot burner, 18. Also, turning the shut-off element, 19, opens the gas passage to gas outlet side connecting pipe 11 and detection burner, 20. Number 21 is an igniter, 22 is an ignition plug placed close to the flame outlet at pilot burner 18, 23 is the valve seat of electromagnetic valve 14 which is provided mid-way in the gas flow system between inlet side connecting pipe 10 and shut-off element 19. Aforementioned electromagnetic valve 14 is composed of a valve, 25, which is forced toward valve seat 23 via a spring, 24, and an attraction plate, 27, that is made of magnetic material and placed facing an electromagnet, 26.

Also, detection burner 20 is equipped with an inside cylinder, 31, which is provided with a nozzle, 28,

and a primary air inlet, 29, close to this nozzle 28, and a primary flame outlet, 30, at the upper edge, and an outside cylinder, 34, which is placed around aforementioned inside cylinder 31, and provided with an auxiliary air inlet, 32, at the lower area, and a secondary flame outlet, 33, over primary flame outlet 30 at the upper edge. 35 is a thermocouple placed facing primary flame outlet 30 and connected to the coil, 36, of said electromagnet 26.

With the above-described structure, heating appliances a, b, c..... cannot be used if gas main passage 1 is not open.

Now, when operation axle 15 is pushed via operation knob 4 (*sic*), valve 25 is pushed until attraction plate 27 comes in contact with an electromagnet 26 and, thus, valve seat 23 is opened. At the same time, pilot valve 16 opens and gas is supplied to pilot burner 18. Next, when operation axle 15 is turned, igniter 21 is activated and an arc is generated at ignition plug 22, pilot burner 18 is ignited and, with rotation of shut-off member 19, the gas passage to gas outlet side connecting pipe 11 and detection burner 20 is opened. Thus, gas main passage 1 is opened and gas is guided to the cocks of heating appliances a, b, c..... Also, at detection burner 20, blown-out gas from nozzle 28 induces primary air through primary air inlet 29, and flows out as mixed gas from primary flame outlet 30 of inside cylinder 31, further induces a small amount of air through auxiliary air inlet 32, and, finally, flows out from secondary flame outlet 33. Then, when detection burner 20 is ignited by pilot burner 18, a primary flame, A, and a secondary flame, B, are formed separately at primary flame outlet 30 and secondary flame outlet 33, respectively.

When primary flame A is formed, thermocouple 35 is heated by it (primary flame A), thermoelectromotive force is generated, and coil 36 of electromagnet 26 is magnetized.

Therefore, even when the pushing force on operation axle 15 is released at this time and pilot burner 18 is extinguished, gas main passage 1 is kept open and the burning of detection burner 20 is maintained because attraction plate 27 integrated with valve 25 is attracted by electromagnet 26 and electromagnetic valve 14 is kept open.

Incidentally, as described in patent S51-51725 (S52-134137) proposed by this same applicant, flame separation type detection burner 20 is sensitive to oxygen concentration in the burning air, and when the oxygen concentration drops, there is a lifting of primary flame A. Therefore, when the air in room 3 is

contaminated by the burning operation of heating appliances a, b, c, and an oxygen deficiency state occurs, primary flame A of detection burner 20 is lifted and the thermo-electromotive force of thermocouple 35 is lessened, and then electromagnetic valve 14 closes gas main passage 1. Thus, the operation of heating appliances a, b, c is limited to only when the air in room 3 is fresh, resulting in prevention of accidents caused by an oxygen deficiency, CO (generation), or an explosion due to an unburned gas flow.

Also, case 4 of oxygen deficiency safety device 2 promotes a convection current and activates air flow into detection burner 20 and, therefore, the oxygen deficiency safety device, even if it is placed in one corner of room 3, can detect the air contamination level. Of course, in certain cases, a small output fan motor can be provided inside case 4.

Next, Fig. 4 shows another thermocouple, 35', which is heated by secondary flame B, which is connected to the other thermocouple, 35, in a same-pole connection manner. There is a difference in the outputs from thermocouples 35 and 35', and this output difference maintains the opening of electromagnetic valve 14.

With the structure shown in Fig. 4, a small difference in primary flame A leads to a large output difference, thus, the oxygen concentration for closure of electromagnetic valve 14 can be (set) elevated, or a variation in burning due to a variation in the gas composition or gas pressure can be assuredly countermeasured.

Further, Fig. 5 shows a linkage between the opening motion of electromagnetic valve 14 and the electrical switch, 37. With this structure, when gas main passage 1 closes with the operation of oxygen deficiency safety device 2, a ventilating fan can be driven or a warning means can be operated.

Also, if inlet/outlet 5, 7 of case 4 are covered with wire-netting, etc., an explosion-proof function can be provided.

Also, thermocouple(s) were used for burning detection in the above working example(s) but photo-sensing components such as CdS, or "thermal-reactive" components such as bimetals can be used along with the electrical power source.

As described in the above, according to this invention, gas is shut off at the main when the air becomes contaminated before an oxygen deficiency state occurs in the room and, thus, human accidents caused

by CO generation can be prevented, and superior effects in terms of safety can be expected.

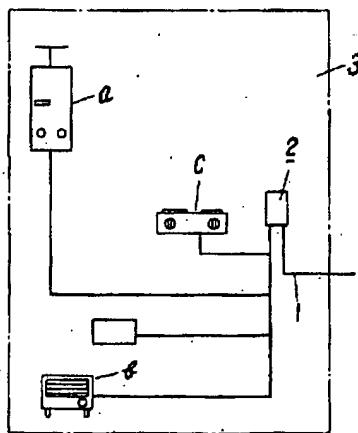
#### **4. Brief Explanation of the Drawings**

Figure 1 shows a layout example of the oxygen deficiency safety device. Fig. 2 is a diagonal view drawing of a working example of the oxygen deficiency safety device, and Fig. 3 is a cross section draw (of the device in Fig. 2). Fig. 4 and Fig. 5 are the cross sections of other working examples.

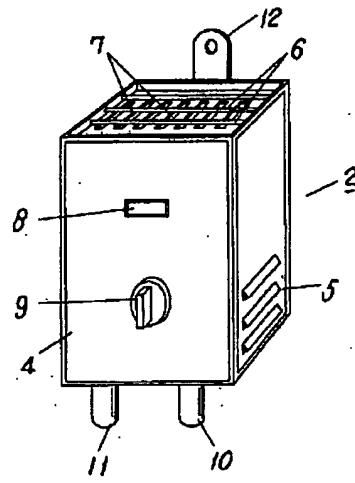
- 1 ..... Fuel passage (main gas passage)
- 4 ..... Case
- 5 ..... Air inlet
- 7 ..... Air outlet
- 14 ..... Valve (electromagnetic valve)
- 20 ..... Detection burner
- 30 ..... Primary flame outlet
- 33 ..... Secondary flame outlet
- 35, 35' ..... Burning detection sensors (thermocouples)
- 37 ..... Electrical switch

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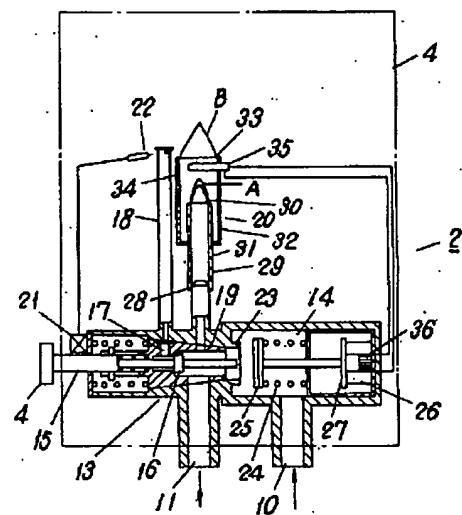
[Fig. 1]



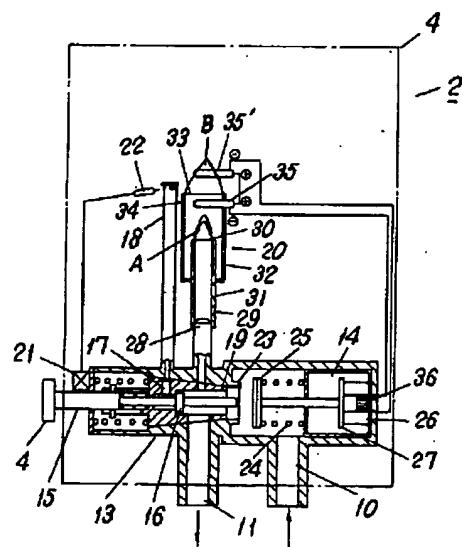
[Fig. 2]



[Fig. 3]



[Fig. 4]



[Fig. 5]

